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HABITAT UTILIZATION OF MAMMALS IN A MAN-MADE FOREST IN THE SANDHILL REGION OF NEBRASKA

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The Sandhill Region of Nebraska, an area of approximately 50,000 square kilometers, is located in the northern and central part of the state. The region is characterized by a topography of rolling sand dunes covered with native grasses. The Bessey Division of the Nebraska National Forest lies within the Sandhills. Originally referred to as "The Dismal River Forest Reserve," the forest later was renamed in honor of Dr. Charles Edwin Bessey of the University of Nebraska. Dr. Bessey, a botanist, was the dominant figure in the inception and subsequent establishment of the Nebraska National Forest (Pool, 1953). The Bessey Division encompasses 36,622 hectares of which approximately 8000 hectares consist of a man-planted forest. The remaining 28,525 hectares are primarily native grasslands. This division represents the largest man-made forest in the National Forest System of the United States (Hunt, 1965).

Research was conducted on the Bessey Division to determine what effect this man-made forest has had on native mammals inhabiting the Sandhills. To accomplish this objective, we compared the relative abundance and species composition of mammals in native and man-made habitats of the Bessey Division.

Prior to planting the forest in the early 1900s, native habitats in the Sandhills consisted of grasslands and narrow bands of riparian communities along rivers and around lakes and potholes. A few scattered trees probably occurred in the grassland

habitat, but there was no forest as there is on the Bessey Division today. Mammals living in the native habitats on the reserve today most likely represent those species that occurred in the area prior to afforestation. By determining the present distribution of mammals on the Bessey Division, we were able to reveal how mammals responded to the presence of a coniferous forest in the Sandhills of Nebraska. In this study, we evaluate each species as to whether or not it has 1) been inhibited in its local distribution or decreased in relative numbers because of the man-made forest, 2) expanded its range on the forest property or increased in numbers because of the plantations, or 3) showed little or no change in its distribution or numbers as a result of afforestation.

Methods and Materials

The Bessey Division of the Nebraska National Forest is located in Thomas and Blaine counties, near the town of Halsey (Fig. 1). Our field studies on mammals of the Bessey Division began in September 1978 and ended in June 1988. Systematic trapping was conducted in native (grasslands and riparian communities) and man-made habitats (plantations) to determine the relative abundance and species composition of mammals in those habitats. When evaluating the response of each species to the man-made forest, information from native habitats served as our controls. We used Sherman live-traps to capture most species, especially small-bodied, ground-foraging types. In the afternoon, traps were baited with oatmeal, millet, and sunflower seed and were set approximately 10 meters apart in various habitats. The following morning, mammals captured were identified, their sex determined, and released. We prepared some animals from each habitat as voucher specimens, and they are deposited at the University of Nebraska at Omaha or the University of Nebraska State Museum at Lincoln. Traplines were concurrently set in native and man-made habitats to reduce bias if inclement weather occurred. Traplines were not left in the same area for more than one night. Small pitfall traps also were set in the various habitats; these, however, were left for several days. We used specialized commercial traps to capture moles and pocket gophers. Snap traps baited with peanut butter and oatmeal were used only in and around buildings on the forest property.

We collected data on all types of mammalian sign in all habitats, including presence of fecal material, evidence of mole tunnels, pocket gopher mounds, porcupine workings, and beaver

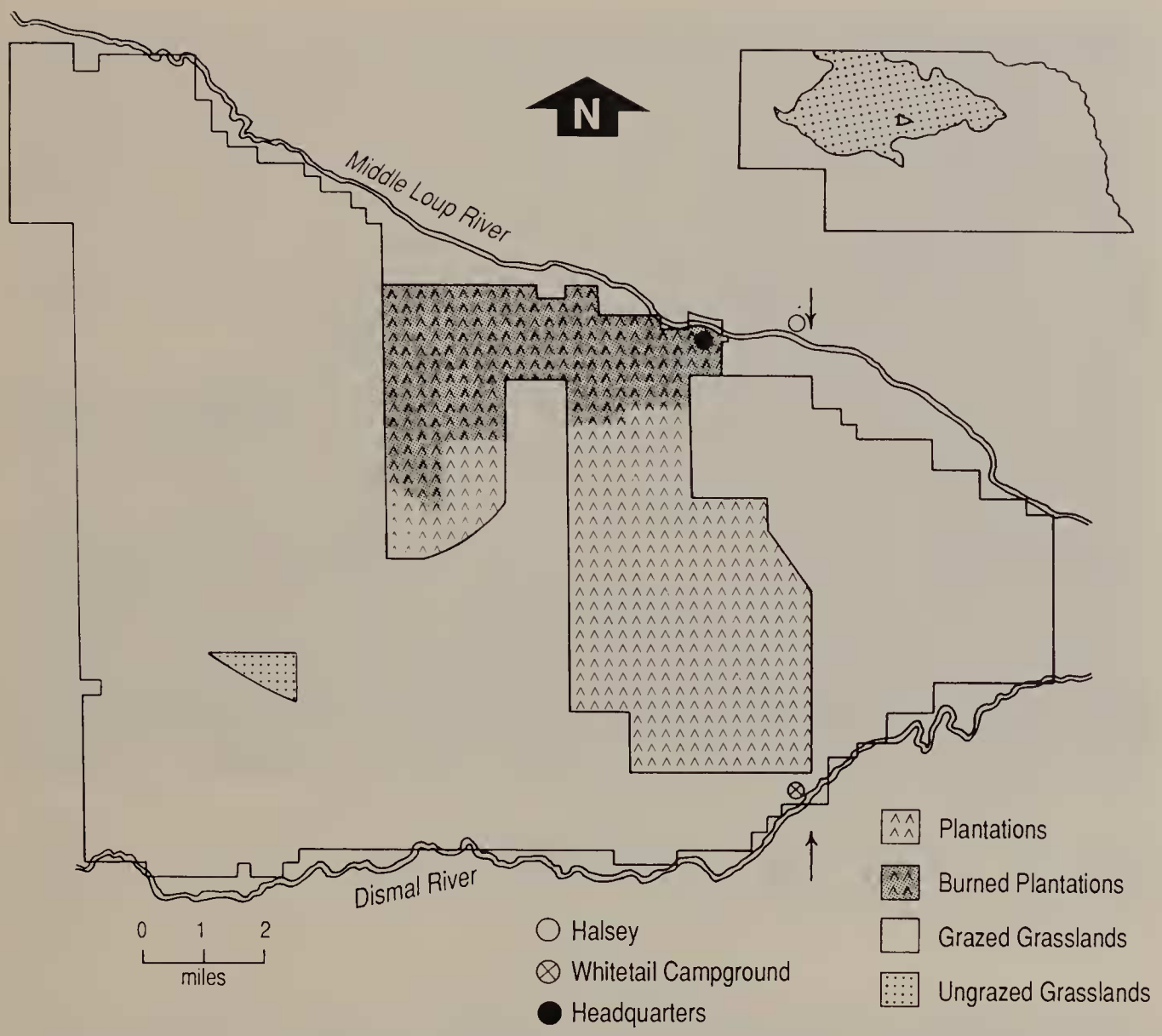

FIG. 1.—Major habitats of the Bessey Division of the Nebraska National Forest. Monocultures of coniferous trees (plantations) constitute the man-made forest on the reserve. The remaining land is primarily native grasslands, either grazed or ungrazed by cattle. Riparian communities occur along certain stretches of both rivers. Arrows indicate where the county line passes through the forest property—Thomas County to the west and Blaine County to the east. The Sandhill Region of Nebraska is shown as the stippled area in the inset.

and muskrat cuttings. We also recorded all visual encounters with mammals. Collecting bats required the use of mist nets, which were set over metal stock tanks and earthen ponds. Buildings on the forest property were inspected periodically to determine if bats were using them as roosting sites.

DESCRIPTION OF HABITATS

The Sandhill Region of Nebraska, located in the northern and central parts of the state (Fig. 1, inset), is characterized by a topography of rolling sand dunes covered with native grasses. These dunes vary in height from one meter to more than 60 meters. Soils of the dunes are classified as fine sand, whereas

those along the river valleys are loamy fine sand. Elevation near Halsey is 820 meters above sea level. Annual precipitation in the Sandhills varies from 41 to 58 centimeters; in the Halsey area, an average of 52 centimeters falls each year. Winters are cold and summers are warm in Thomas County; minimum and maximum daily temperatures average -12.1°C and 2.0°C for January and 16.2°C and 32.2°C for July. Information above is taken from Bose (1977) and Sherfey *et al.* (1965).

Dominant vegetation of the Sandhills has been described as an association of bluestem grasses (*Andropogon*), sandreed (*Calamovilfa*), needlegrass (*Stipa*), and yucca (*Yucca*) (Kaul, 1975; Küchler, 1964). For detailed accounts of vegetation in the Sandhills, see Bose (1977), Burzlaff (1962), Kaul (1989), Sherfey *et al.* (1965), and Weaver (1965). The Bessey Division is located in a portion of the Sandhills known as the "choppy Sandhills," an area consisting of belts of steep, rough dunes interspersed among belts of lower, smoother dunes (Sherfey *et al.*, 1965). Fieldwork was conducted in each of the three major habitats on the Bessey Division; a description of these habitats and their subdivisions follows.

Riparian Habitats

Rivers flow along the northern and southern boundary of the Bessey Division, the Middle Loup on the north and Dismal on the south (Fig. 1). Riparian communities occur along certain stretches of these rivers; otherwise, grasslands simply abut them. Along the Middle Loup River, the riparian zone exists mainly as continuous bands of vegetation on both banks in the central part of the reserve. All our trapping along this river was conducted in the vicinity of the headquarters near the nurseries, maintenance yard, and campgrounds. Here the riparian community is approximately 85 meters at its widest spot. A few traplines in the area of the campgrounds were on, or just beyond, the forest boundary line. Along the Dismal River, the riparian zone is discontinuous on both banks; the isolated areas with trees occur mostly in the eastern part of the national forest. We trapped only in the vicinity of Whitetail Campground along the Dismal. Here the band of riparian vegetation is approximately 120 meters wide.

Two major subdivisions of the riparian communities are apparent—a subirrigated portion adjacent to the rivers and a well-drained, higher habitat farther from the water (Fig. 2). These habitats are detailed below.

FIG. 2.—Riparian habitats along the Middle Loup River. Wet subirrigated areas adjacent to the river are dominated by cattails, sedges, and grasses, whereas higher, well-drained areas are farther from the water and are dominated by deciduous trees and bushes.

Subirrigated areas.—Within the riparian habitat, there are areas immediately adjacent to the rivers that are subirrigated and wet. Soggy areas and standing water are common, especially in spring. This habitat is dominated by cattails (*Typha latifolia*), sedges (*Carex*), reed canary grass (*Phalaris arundinacea*), goldenrod (*Solidago*), willow (*Salix*), and red osier dogwood (*Cornus stolonifera*). The Dismal River has fewer and narrower bands of subirrigated habitat than the zone along the Middle Loup. Where we trapped, the bands were 30 meters and 40 meters at their widest extent on the Dismal and Middle Loup rivers, respectively.

Well-drained areas.—These are areas farther from the water that are higher and drier than the subirrigated habitat. Along the Middle Loup River, dominant trees in the well-drained habitats include cottonwood (*Populus deltoides* var. *monilifera*), green ash (*Fraxinus pennsylvanica*), Siberian elm (*Ulmus pumila*), boxelder (*Acer negundo*), hackberry (*Celtis occidentalis*), and eastern red cedar (*Juniperus virginiana*). Other plants in these drier areas include wild plum (*Prunus americana*), eastern chokecherry (*Prunus virginiana*), indigo plant (*Amorpha fruticosa*), river bank grape (*Vitis riparia*), poison ivy (*Toxicodendron*), Virginia

creeper (*Parthenocissis vitacea*), stinging nettle (*Urtica dioica*), goldenrod, European brome (*Bromus inermis*), switchgrass (*Panicum virgatum*), orchard grass (*Dactylis glomerata*), sand bluestem (*Andropogon hallii*), and wild rye (*Elymus villosus*). The grasses exist mainly in small open areas or clearings that are surrounded by bushes and trees and along the banks where the edges of subirrigated areas meet those that are well-drained. Dead trees, fallen branches, and pieces of exfoliated bark are fairly common in this subdivision. Leaf litter is thickest in the wooded areas, although some leaves have accumulated in the clearings. Where we trapped along the Middle Loup River, the well-drained area was 45 meters wide at the widest point.

Along the Dismal River, dominant species of trees include cottonwood, hackberry, and green ash. Other common types of vegetation are wild plum, snowberry (*Symphoricarpos occidentalis*), Virginia creeper, poison ivy, little bluestem (*Andropogon scoparius*), and blue grama (*Bouteloua gracilis*). This community is relatively more open with more grass and has less debris from trees than along the Middle Loup. At Whitetail Campground, the well-drained area was 90 meters wide.

Grasslands

Grazed grasslands.—Seasonal grazing of cattle, supervised by forestry personnel, is allowed on most grassland areas of the Bessey Division. Dominant grasses on these grazed areas include little bluestem, prairie sandreed (*Calamovilfa longifolia*), needle-and-thread (*Stipa comata*), switchgrass, and blue grama. Common shrubs and forbs include sand cherry (*Prunus pumila* var. *besseyi*), wild plum, snowberry, New Jersey tea (*Ceanothus herbaceous*), leadplant (*Amorpha canescens*), prairie mugwort (*Artemisia ludoviciana*), sunflower (*Helianthus rigidus*), wild rose (*Rosa arkansana*), prickly pear (*Opuntia*), and yucca. The grazed portions of the grasslands are rather uniform in appearance, and plants often are grazed to a low profile (Fig. 3). In many areas, the grasslands have blowouts and catstepped slopes, and we have treated these areas as a separate subdivision of the grasslands (see below).

Ungrazed grasslands.—A 283-hectare plot was set aside on the Bessey Division in 1950 and designated as a "Natural Area" (Fig. 1). This tract of land remains fenced and free of grazing from cattle. No improvements (wells or roads) have been made on this land. The grass is not mowed, and prescribed burns are not part

FIG. 3.—Grazed portion of the native grassland on the Bessey Division. Dominant grasses include little bluestem, prairie sandreed, and needle-and-thread.

of the management plan for this plot. Dominant grasses include little and sand bluestem, prairie sandreed, needle-and-thread, sand lovegrass (*Eragrostis trichodes*), prairie June grass (*Koelaria pyramidata*), and switchgrass. Forbs and shrubs are the same as those on grazed areas. Ungrazed areas resemble grazed areas in topographic features; not surprisingly, however, vegetation is taller and thicker, and ground cover is denser (Fig. 4).

Blowouts and catstepped areas.—These exposed sandy areas commonly are found in the grasslands. Blowouts are large, open, sandy depressions that usually have a "scooped out" appearance (Fig. 5). Catstepped areas often occur on steep-sloped areas of the sandhills. On these slopes, series of flat, open strips have been cut into the banks of sand dunes. These areas have a terracelike appearance (Fig. 6). Catstepped areas are primarily associated with trampling and trailing by livestock. Sparse vegetation found in these sandy places include sandhill muhly (*Muhlenbergia pungens*), blowout grass (*Redfieldia flexuosa*), blue grama, sedges, yucca, prickly pear, and wild rose.

Plantations

Monocultures of coniferous trees constitute the man-made forest on the Bessey Division. Of the total number of trees present

FIG. 4.—A fenced area separates grazed (left) and ungrazed (right) portions of native grasslands on the Bessey Division. Not surprisingly, vegetation is taller and thicker in the absence of grazing from cattle or mowing.

FIG. 5.—Blowouts are large scooped-out depressions in sand dunes. These sandy areas are common throughout the Bessey Division.

FIG. 6.—A catstepped slope in the Bessey Division. Exposed strips of sand on the banks of the dunes give the slopes a terracelike appearance.

today, 68.8 percent are ponderosa pine (*Pinus ponderosa*) with eastern red cedar (*Juniperus virginiana*) and jack pine (*Pinus banksiana*) constituting 20.5 percent and 10.2 percent, respectively. The remaining conifers consist of Scotch pine (*Pinus sylvestris*), Austrian pine (*Pinus nigra*), and red pine (*Pinus resinosa*). Trees were planted equidistantly in straight rows. Today, some natural reproduction of these conifers occurs on the property. Cattle are allowed to roam through some of the plantations. We investigated habitat utilization of mammals only in the three main monocultures and their descriptions follow. Information regarding boundary lines of the forest property and plantations, and the number of trees planted and thinned, are based on the most recent information available from forest personnel.

Cedar plantations.—Cedar trees were planted in rows approximately two to three meters apart, the trees individually spaced about one to two meters apart. Diameter at breast height averages 11 centimeters. A mixture of seeds, small fleshy cones, and leaves from the cedars cover the ground; this litter is 0.6-2.5 centimeters deep and allows for only a thin scattering of monocots under the canopy. Lower branches are dead and overlap with those of

FIG. 7.—Looking into a plantation of eastern red cedars. Lower branches overlap with adjacent trees making stands nearly impenetrable to man.

adjacent trees, making the stands extremely thick and nearly impenetrable to man (Fig. 7). Small open areas occasionally exist among the trees, and here the litter is sparse and the sandy soil exposed. Prickly pear also is found growing at scattered sites throughout these stands. A small portion (0.8 percent) of the cedar plantations has been thinned (every third row removed) by forest personnel, but we trapped only in unthinned stands.

Ponderosa pine plantations.—Trees of these plantations are in rows approximately two to three meters apart and spaced about two to three meters from one another (Fig. 8). Diameter at breast height of these pines averages 25 centimeters. An accumulation of pine needles covers the ground. Litter is deepest (15 to 20 centimeters) near the base of the trees and thinner (eight to 10 centimeters) farther from the main trunks. Because of this litter, there is essentially no other vegetation; however, poison ivy, prickly pear, and monocots occur in a few small scattered openings where needles are not abundant. Only a few areas exist where dead trees or their branches have accumulated into brush piles or snags. Some stands (three percent) have been thinned (alternate trees cut and removed), but we trapped only in unthinned stands.

FIG. 8.—A plantation of ponderosa pine surrounds a grassy clearing containing an earthen pond.

Jack pine plantations.—This coniferous species also was planted in rows, approximately two to three meters apart and individually spaced about two to three meters apart. Diameter at breast height averages 20 centimeters. Litter accumulation is five to 10 centimeters deep directly below the trees and slightly less away from the base. More light reaches the ground in stands of jack pine than in those of ponderosa pine because jack pines have fewer and shorter branches and their needles are smaller (Fig. 9). Some stands (11.8 percent) have been thinned (alternate trees cut and most removed), and in these relatively open areas, poison ivy grows in thick patches. Other understory vegetation includes snowberry, eastern red cedar, and monocots. Many tree trunks and branches are scattered throughout these thinned areas. Most of our trapping in stands of jack pine was conducted in areas that had been thinned.

Burned plantations.—As a result of the forest fire of 1965, an estimated 3000 hectares of trees were destroyed (Fig. 1). This fire, which occurred in the northern part of the plantations, created a different habitat. It is characterized by scattered clumps or stands of pine and cedar (that survived the fire) interspersed with grassy areas (Fig. 10). Deteriorating logs are abundant on the ground

FIG. 9.—Plantation of jack pine that has been thinned.

throughout the burned plantations. Only small amounts of litter occur under and around the trees. Young cedars, ponderosa pine, and jack pine saplings have invaded the open grassy areas. Bluestem grasses, prairie sandreed, needlegrass, sand lovegrass, switchgrass, and prairie June grass commonly are found in the burned plantations as are yucca, sand cherry, wild plum, snowberry, poison ivy, prickly pear, wild rose, and leadplant. Certain areas of the burned plantations are not grazed by cattle; in these areas, grasses are nearly as thick as in the "Natural Area." Blowouts and catstepped areas also occur in the burned areas, but we did not trap in these sandy habitats of the plantations. Basically, burned plantations are grasslands with scattered trees and many fallen logs.

RESULTS

The following accounts of species inhabiting the Bessey Division of the Nebraska National Forest are based primarily on mammals collected and observed during our study. For example, we collected detailed information on 14 species from a live-trap study in which we captured 580 animals in 4833 trap nights in the nine defined habitats (Table 1). Additional information is based on accounts from the literature, specimens examined in

FIG. 10.—The fire of 1965 turned a large part of the man-planted forest into a different habitat, as shown in the foreground. Here, clumps of conifers and single trees are scattered throughout the grassland. The fine textured vegetation in the center is a plantation of eastern red cedars. Stands of unburned pines are in the distance. Prior to afforestation, the land in this photograph looked like that in Figure 3.

museums (209), and personal communication with forest personnel and colleagues who have observed or collected mammals on the forest property. Common and scientific names follow Jones and Choate (1980) and Jones *et al.* (1986). Except for *Sorex cinereus* (see van Zyll de Jong and Kirkland, 1989), subspecific names are based on information in Jones (1964) and Hall (1981).

Didelphis virginiana virginiana Kerr, 1792

Virginia Opossum

Although we failed to obtain or observe an opossum during our study, this animal is occasionally found dead on roads just north of the forest (P. Clark, personal communication). Jones (1964) reported a specimen from Thomas County (no specific locality), and considered the species rare in the Nebraska Sandhills. On the Northern Great Plains, opossums are most common in wooded habitats, especially along rivers and streams; however, they occasionally are found in open areas with scattered trees (Jones *et al.*, 1983). We suspect that opossums eventually

TABLE 1.—*Results of a live-trap study on the Bessey Division of the Nebraska National Forest at Halsey. Numbers indicate individuals captured per 100 trap nights. Numbers in parentheses indicate total number of animals captured.*

	Riparian Habitats		Grasslands			Plantations			
Species	Sub-irrigated	Well-drained	Grazed	Ungrazed	Blowouts and catsteps	Cedar	Ponderosa pine	Jack pine	Burned
Sorex cinereus (4)	1.1	0.1	—	—	—	—	—	—	—
Blarina brevicauda (7)	2.2	0.1	—	—	—	—	—	—	—
Cryptotis parva (1)	—	—	—	—	—	—	—	—	0.1
Perognathus flavescens (64)	—	—	1.5	2.1	0.8	3.3	—	0.3	2.5
Chaetodipus hispidus (4)	—	—	—	—	—	0.9	—	—	—
Dipodomys ordii (88)	—	—	0.4	0.2	4.9	4.7	—	—	2.3
Reithrodontomys megalotis (22)	1.8	0.6	0.2	1.4	—	—	0.3	—	0.5
Reithrodontomys montanus (2)	—	—	0.2	0.2	—	—	—	—	—
Peromyscus leucopus (199)	6.5	14.2	—	—	—	10.9	0.7	3.3	2.2
Peromyscus maniculatus (131)	—	0.1	2.6	6.8	0.8	5.6	6.0	0.7	3.6
Onychomys leucogaster (8)	—	—	0.4	0.5	—	0.9	—	—	—
Microtus pennsylvanicus (26)	8.7	0.3	—	—	—	—	—	—	—
Microtus ochrogaster (20)	—	1.9	—	0.7	—	—	—	—	0.4
Zapus hudsonius (4)	0.7	0.3	—	—	—	—	—	—	—

will be found in the Bessey Division, utilizing at least the riparian communities and the burned plantations.

Sorex cinereus lesueurii (Duvernoy, 1842)

Masked Shrew

This shrew is uncommon on the Bessey Division. During our fieldwork only seven were captured (four live-trapped and three taken in pitfall traps). The masked shrew inhabits the subirrigated floodplain and the well-drained areas (both grassy and wooded) of riparian habitats along the Middle Loup River (Table 1). We did not capture any along the Dismal River, but Jones (1964) reported one specimen from along this river on or near the forest property. None was taken in any other habitat on the Bessey Division.

Blarina brevicauda brevicauda (Say, 1823)

Northern Short-tailed Shrew

Although a common species in eastern Nebraska, this shrew has not been reported previously from this part of the state (Jones, 1964). We captured seven individuals along the Middle Loup River—six on the lush, subirrigated floodplain and one in the well-drained grassy area of the riparian system (Table 1). This species appears to be restricted to riparian communities, because none was taken in any other habitat.

Cryptotis parva parva (Say, 1823)

Least Shrew

In the northern plains region, least shrews seem to prefer dry, grassy habitats (Jones *et al.*, 1983). Only two specimens were examined from the Bessey Division. We captured one on a grassy slope of the burned plantation (Table 1). The other, according to information on the specimen label (University of Nebraska State Museum), also was taken in the burned plantation. Apparently, least shrews are rare in this region of the state but may prove to be more numerous with selective trapping (Jones, 1964).

Scalopus aquaticus caryi Jackson, 1914

Eastern Mole

Evidence of mole activity commonly was seen in moist soils of riparian communities along the Middle Loup and Dismal rivers, in burned and unburned plantations (except in cedars), as well as

in ungrazed grasses far from the river. Mole activity also was observed occasionally in grazed areas. We detected the greatest amount of mole activity in ponderosa pine plantations. Active tunnels criss-crossed roads in these stands, and evidence of previous activity was apparent beneath the litter (underneath the canopy and around the base of the trees). Three specimens were collected, one in each of the following habitats—the well-drained area along the Middle Loup River, in a ponderosa pine plantation, and in the ungrazed grassland. The grassland specimen came from a well-drained, upland area six kilometers from the nearest riparian system.

Lasiurus borealis borealis (Müller, 1776)

Red Bat

We netted two male red bats on 16 October. One was captured over a metal stock tank (surface area 29 square meters) and the other over an earthen pond (surface area about 65 square meters) in a clearing (approximately 65 by 35 meters) surrounded by ponderosa pines (Fig. 8). This plantation is 5.5 kilometers from the nearest riparian habitat. One additional male was captured at the same locality (over the pond) the following evening. It is probable that these three bats were migrating to their winter destinations.

Lasiurus cinereus cinereus (Palisot de Beauvois, 1796)

Hoary Bat

On 5 June, we netted a pregnant female over the earthen pond described in the previous account. She carried two well-developed fetuses with forearm lengths of 18.0 and 18.5 millimeters. Females of this migratory species are known to raise their young in Nebraska (Czaplewski *et al.*, 1979). Our specimen most likely represents a summer resident of the forest. Jones (1964) reported a hoary bat from 1 mi. W Halsey on the Bessey Division. This specimen, a lactating female, was shot on 6 July 1957 as it flew along the south bank of the Middle Loup River (J. K. Jones, Jr., personal communication).

Lasionycteris noctivagans (Le Conte, 1831)

Silver-haired Bat

Our only specimen from the Bessey Division is a male that was captured on the same night and at the same pond as the hoary

bat mentioned above. Although this bat probably represents a late migrant, the possibility exists that some silver-haired bats may reside in the forest throughout the summer months. It also should be noted that a few individuals of this species have been found hibernating at latitudes north of Nebraska (Jones *et al.*, 1983).

Eptesicus fuscus pallidus Young, 1908

Big Brown Bat

We obtained one specimen from the Bessey Division. This individual was taken in April from a cavelike, concrete storage building where seedlings are stored. In October, we examined a bat roost (detected by the presence of fecal droppings) in an adjacent building, but found no bats. We were told by forestry personnel that "small brown" bats periodically have been found in these buildings, especially during spring and autumn. They probably are used as hibernacula. We were unable to capture big brown bats or any other species of bats during the summer on the forest property.

Sylvilagus floridanus similis Nelson, 1907

Eastern Cottontail

In central Nebraska, this species is somewhat restricted to wooded areas along waterways (Jones, 1964). On the Bessey Division, we observed it frequently in riparian communities of the Middle Loup and Dismal rivers. Cottontails also were common in and near cedar stands and in burned areas. None was observed, nor their sign, in ponderosa or jack pine plantations or in grassland habitats.

Lepus californicus melanotis Mearns, 1890

Black-tailed Jackrabbit

This species of the open plains is found throughout most of Nebraska but is more common in the southern half of the state (Jones, 1964; Jones *et al.*, 1983). We did not take any of these hares, nor did we see any, on the Bessey Division during our study. A road-killed hare of this species was seen in a grazed area of rolling grassland approximately eight kilometers west of the forest property.

Lepus townsendii campanius Hollister, 1915

White-tailed Jackrabbit

In Nebraska, this hare is limited mostly to areas north of the Platte River, especially in areas of open vegetation (Jones, 1964; Jones *et al.*, 1983). We have one sight record for this species in the grazed grasslands on the Bessey Division during our study. An individual was observed near a prairie dog town on the southern part of the property, near the Dismal River. Jackrabbit populations (both species) have declined drastically over the past 25 years on the Bessey Division (G. Mandeville, personal communication).

Spermophilus franklinii (Sabine, 1822)

Franklin's Ground Squirrel

This species is most frequently associated with tall-grass habitats in eastern Nebraska. Specimens have been reported from "along rivers" in Thomas County (see Jones, 1964). We have a single sight record from about 20 kilometers east of the forest property. This animal was seen in tall grass along a road near the Middle Loup River. This monotypic species probably occurs in relatively low numbers in tall grassy habitats on the forest property.

Spermophilus spilosoma obsoletus Kennicott, 1863

Spotted Ground Squirrel

Jones (1964) reported one specimen from Halsey, Thomas County. We know of only one specimen from the Bessey Division of the Nebraska National Forest (at Kearney State College). This specimen is a juvenile female that was trapped in a sandy blowout near the Dismal River at the eastern end of the forest property. The trap was placed by an open, active burrow, thought to have been made by a kangaroo rat (R. Timm, personal communication).

Spermophilus tridecemlineatus pallidus J. A. Allen, 1877

Thirteen-lined Ground Squirrel

Two specimens were collected by hand near a prairie dog town in the sparsely vegetated, grazed grasslands on the southern part of the forest reserve. Another individual was seen near a different prairie dog town southeast of this locality in similar habitat (P.

Clark, personal communication). Although this species is commonly found in grassy habitats in Nebraska (Jones, 1964), it is uncommon on the Bessey Division.

Cynomys ludovicianus ludovicianus (Ord, 1815)

Black-tailed Prairie Dog

Isolated populations (at least five) of prairie dogs are known on the Bessey Division, notably in open, flat areas of grazed, short-grass habitats in the southern and western parts of the forest property. Soils in these areas have a higher clay content than those in other areas on the property, which make them more suitable for the extensive burrow systems of this fossorial mammal.

Sciurus niger rufiventer Geoffroy St.-Hilaire, 1803

Fox Squirrel

This arboreal species is distributed primarily along major river systems in western Nebraska (Jones, 1964). Fox squirrels were seen regularly in the riparian habitat along the Middle Loup River. However, we also saw them in stands of ponderosa and jack pine, eight kilometers from the nearest riparian habitat. One was observed in a burned plantation. We never observed this squirrel in cedar plantations.

Geomys bursarius lutescens Merriam, 1890

Plains Pocket Gopher

Pocket gophers are abundant on the Bessey Division. Mounds frequently were observed in the grasslands, burned plantations, and along well-drained areas of riparian habitats. Occasionally, we found a row of mounds connecting two open fields by crossing a narrow strip of conifers. Otherwise, gopher mounds were absent within the monoculture plantations. A lack of vegetative ground cover, which would provide a potential source of food, and the dense root systems found under the trees seem to exclude gophers from the plantations.

Perognathus flavescens flavescens Merriam, 1889

Plains Pocket Mouse

In Nebraska, plains pocket mice are most abundant in the Sandhills, because they prefer relatively sandy soils (Jones, 1964).

On the Bessey Division, these mice were captured in all grassland habitats and plantations except ponderosa pine (Table 1). Although we captured 64 individuals, none was taken in ponderosa pines and only one in a thinned area of jack pine. Exclusion from stands of ponderosa pine probably is related to the heavy accumulation of needles beneath these trees. No pocket mice were taken in riparian habitats.

Perognathus flavus piperi Goldman, 1917

Silky Pocket Mouse

One specimen from the Bessey Division was reported to us by Robert M. Timm and is deposited at the Field Museum of Natural History. He trapped the mouse near the Dismal River in the southeastern part of the reserve on 25 May 1985. The habitat was described as a blowout area in grazed grassland. Another silky pocket mouse from the forest property was collected by Robert E. Martin on 16 August 1972 and is housed at Texas Tech University. He captured this animal and four *Perognathus flavescens* in a trapline placed in grazed grassland.

Chaetodipus hispidus paradoxus (Merriam, 1889)

Hispid Pocket Mouse

Hispid pocket mice evidently are rare on the Bessey Division. We captured only four individuals during our study, all taken in cedar plantations under the dense canopy of branches (Table 1). With additional trapping, hispid pocket mice should be found in some areas of the grasslands and burned plantations, as "vegetation of mid- and short-grasses, shrubs, forbs, cacti, and yucca characterizes their habitat" (Jones *et al.*, 1983).

Dipodomys ordii luteolus (Goldman, 1917)

Ord's Kangaroo Rat

Ord's kangaroo rat is a common inhabitant of the Sandhills of Nebraska (Jones, 1964). This heteromyid was captured in all grassland habitats, especially around sandy blowouts and along catstepped slopes (Table 1). At these sites, active burrow openings were always quite noticeable. In addition, kangaroo rats also were common in cedar and burned plantations. Both these plantations contain open, sandy areas with little litter. We captured no kangaroo rats in ponderosa or jack pine plantations or in the riparian community.

Castor canadensis missouriensis V. Bailey, 1919

Beaver

This semiaquatic mammal was observed in the Middle Loup River. Jones (1964) cited one record of this rodent from the Dismal River in Thomas County. We frequently found evidence of feeding and gnawing on trees and saplings in the riparian habitats along both rivers.

Reithrodontomys megalotis dychei J. A. Allen, 1895

Western Harvest Mouse

Western harvest mice are fairly common on the Bessey Division, found in a wide variety of habitats, both wet and dry (Table 1). For example, highest numbers were taken in the wet area of riparian habitat, but this species was almost as common in dry, ungrazed grasslands. Some individuals also were captured in burned areas and one was taken in a ponderosa pine plantation. Habitats that seem to exclude this mouse are blowouts and catstepped slopes, cedar stands, and jack pine plantations.

Reithrodontomys montanus albescens Cary, 1903

Plains Harvest Mouse

The plains harvest mouse is much less common than its congener on the Bessey Division. Only two individuals were live-trapped during our study—one each in ungrazed and grazed grasslands (Table 1). We captured one additional *R. montanus* by hand beneath a windmill containing tall vegetation around its base. The windmill was in a large grazed clearing surrounded by ponderosa pines.

Peromyscus leucopus aridulus Osgood, 1909

White-footed Mouse

On the Bessey Division, white-footed mice are common in the riparian community, especially in well-drained areas (Table 1). Large numbers of these mice also were found in dense cedar plantations. We caught some white-footed mice in the burned and pine plantations, but none was trapped in grasslands. This supports the notion that *P. leucopus* is basically a woodland species in Nebraska (Jones, 1964).

Peromyscus maniculatus luteus Osgood, 1905

Deer Mouse

Deer mice are found in virtually all habitats on the Bessey Division, save the wettest parts of the riparian community (Table 1). We trapped the largest number of deer mice in the ungrazed grasslands. Large numbers also were obtained in ponderosa pine and cedar plantations. Fewer animals were taken in jack pine and burned plantations, blowouts and catstepped slopes, and in grazed grasslands. Deer mice were only rarely taken in the riparian community, which is the preferred habitat of the white-footed mouse.

Onychomys leucogaster arcticeps Rhoads, 1898

Northern Grasshopper Mouse

This cricetid is uncommon on the Bessey Division. We live-trapped only eight *Onychomys*—two each in the ungrazed and grazed grasslands and four (all on the same October night) in cedar plantations (Table 1). During our field work, we also verified the identification of a grasshopper mouse (from the burned plantation) captured by students from the 4-H Nature Center. Grasshopper mice were not taken in any other habitats on the forest property.

Microtus pennsylvanicus pennsylvanicus (Ord, 1815)

Meadow Vole

On the Bessey Division, meadow voles are restricted to wet, thickly vegetated, subirrigated portions of the riparian community (Table 1). Occasionally, these rodents were caught on the margin of well-drained riparian habitat. We caught none of these mice in any other habitat.

Microtus ochrogaster haydenii (Baird, 1858)

Prairie Vole

On the Bessey Division, prairie voles were captured in ungrazed grasslands, burned plantations, and the grassy areas of well-drained riparian habitats (Table 1). Because of a lack of thick grass in cedar and pine plantations, these rodents are absent from those habitats. Short, sparse vegetation of grazed grasslands, blowouts, and catstepped slopes is evidently also too thin to

support populations of this species. Conversely, the subirrigated area of the riparian community may be too wet for this vole. Another reason for its absence in the wet areas, however, may be the presence of meadow voles. Jones (1964) stated that prairie voles occupy lush, semimarshy habitats in the absence of meadow voles but are excluded from such habitats where the two species are in direct competition.

Ondatra zibethicus cinnamominus (Hollister, 1910)

Muskrat

In Nebraska, this semiaquatic mammal occurs "in nearly all places where permanent water is found" (Jones, 1964). We observed muskrats along the Middle Loup River. Surely they are restricted to waters of riparian systems on the Bessey Division.

Rattus norvegicus norvegicus (Berkenhout, 1769)

Norway Rat

This introduced species is known to occur statewide (Jones, 1964). Although we took none during our study, it may occur around the buildings on the forest property.

Mus musculus Linneaus, 1758

House Mouse

One mouse was captured in a snap trap set next to a seed-storage building on the forest property. We caught no house mice in any other habitat on the Bessey Division.

Zapus hudsonius pallidus Cockrum and Baker, 1950

Meadow Jumping Mouse

Meadow jumping mice were captured only in riparian habitat along the Middle Loup River. Two individuals were taken in cattails of the subirrigated floodplain and two in tall grass of the well-drained area (Table 1). We observed two others scampering through tall grass of the well-drained area. We also examined five museum skins (at the University of Nebraska State Museum) from a locality along the Dismal River on the forest property. The distribution of *Zapus* on the Bessey Division supports the findings of Jones (1964) that this mammal is restricted to mesic areas of riparian habitats in western Nebraska.

Erethizon dorsatum bruneri Swenk, 1916

Porcupine

Jones (1964) considered this species to be numerous on the Bessey Division but sparingly distributed elsewhere along the Loup drainage in central Nebraska. Porcupines were observed in the burned plantations, and evidence of their feeding on trees was seen in stands of ponderosa and jack pine. We regularly observed an adult porcupine in a culvert (drifted sand blocked one end) under a road on the forest property; on one side of the road was the burned plantation, whereas the other supported a thick stand of ponderosa pine. Johnson and Higgins (1952) reported that 68 of these rodents were killed on the Bessey Division in the winter of 1951-52.

Canis latrans latrans Say, 1823

Coyote

Coyotes are known to occur statewide in Nebraska and are found in a wide variety of habitats (Jones, 1964; Jones *et al.*, 1983). They are abundant on the Bessey Division and can be heard howling virtually every night. Coyotes were seen in burned plantations and grasslands, both grazed and ungrazed. They are known to retreat into, or seek shelter in, thick cedar plantations when hunted in the autumn and winter (P. Clark, personal communication).

Vulpes vulpes regalis Merriam, 1900

Red Fox

We have no specimens of red foxes from the Bessey Division; however, Jones (1964) cited a record from Thomas County with no specific locality. If red foxes do occur on the forest property, they most likely are associated with the riparian woodlands and perhaps the borders of coniferous plantings.

Procyon lotor hirtus Nelson and Goldman, 1930

Raccoon

Raccoons are widespread in Nebraska and usually are found in wooded situations along rivers and around lakes and marshes (Jones, 1964). Although we obtained no specimens, raccoon tracks were seen regularly in mud along the rivers. Raccoons probably are restricted to riparian communities and their adjacent

edges on the Bessey Division, but some individuals may occasionally live in drier, more open areas on the property.

Mustela frenata longicauda Boneparte, 1838

Long-tailed Weasel

Jones (1964) reported one specimen from Thomas County that was collected near Halsey. Long-tailed weasels occur in both forested and open situations and often are found in the vicinity of permanent water (Jones *et al.*, 1983). With further trapping, the presence of long-tailed weasels probably be will established on the Bessey Division. These animals most likely will be encountered in the riparian woodlands and perhaps in plantations.

Mustela vison letifera Hollister, 1913

Mink

Mink are fairly common along watercourses in Nebraska. We did not secure any specimens from the Bessey Division; however, Jones (1964) cited one record from Thomas County with no specific locality. If these semiaquatic mammals are present on the forest property, they surely are restricted to mesic habitats along the Middle Loup and Dismal rivers.

Taxidea taxus taxus (Schreber, 1778)

Badger

Apparently this prairie species is uncommon on the Bessey Division. Refuge personnel reported that badgers are seen only occasionally on the property. Most sightings are in grasslands, burned areas, or near the edge of plantations. One animal was observed running into a stand of cedars (P. Clark, personal communication). Jones (1964) reported one specimen from "near Halsey."

Spilogale putorius interrupta (Rafinesque, 1820)

Eastern Spotted Skunk

Spotted skunks occur throughout Nebraska, but nowhere are they common. There is one record from Thomas County, but no specific locality was given by Jones (1964). Similar to long-tailed weasels, spotted skunks most likely will be encountered in the riparian woodlands and perhaps the plantations.

Mephitis mephitis hudsonica Richardson, 1829

Striped Skunk

This mustelid is common in the Sandhill Region, and road kills are especially evident during spring months. We have sight records of this skunk on the Bessey Division from riparian community of the Middle Loup River and from burned plantations. Jones (1964) reported one specimen taken along the Dismal River on or near the forest property.

Felis rufus rufus Schreber, 1777

Bobcat

Bobcats are only rarely seen on the Bessey Division. G. Mandeville (personal communication) related one sighting of this felid to us: "the bobcat was seen in a ponderosa pine plantation near the Dismal River on the southern portion of the forest." Jones (1964) reported one specimen from Thomas County near Halsey. Bobcats probably range along the rivers in this part of Nebraska and occasionally wander onto the forest property.

Odocoileus hemionus hemionus (Rafinesque, 1817)

Mule Deer

Mule deer are quite common on the Bessey Division and are most often seen in open habitats. We observed them most frequently in grasslands, in burned plantations, and near the edge of unburned plantations. One buck was seen in a ponderosa pine plantation during hunting season. We suspect that mule deer also use cedar plantations, at least for shelter during periods of severe weather. Mule deer were not observed in wooded communities along the rivers.

Odocoileus virginianus macrourus (Rafinesque, 1817)

White-tailed Deer

White-tailed deer are common on the Bessey Division and most often are associated with the riparian community. In addition to this habitat, they frequently are seen in burned plantations and in coniferous forests, either near the edge or among the trees. Occasionally, we saw them in open grasslands.

Antilocapra americana americana (Ord, 1815)

Pronghorn

This grassland species is found in isolated areas on the Bessey Division, especially on the eastern, western, and southern parts of the property away from plantations. Pronghorns were not seen in any of the man-made habitats or in the riparian community.

Extirpated Species

River otters (*Lutra canadensis interior*) and wapiti (*Cervus elaphus canadensis*) occurred in Thomas County in the past but today appear to be absent (Jones, 1964). Other extirpated species that probably occurred in Thomas County include the gray wolf (*Canis lupus nubilus*), swift fox (*Vulpes velox velox*), black bear (*Ursus americanus americanus*), black-footed ferret (*Mustela nigripes*), mountain lion (*Felis concolor hippolestes*), and bison (*Bison bison bison*). For further information on the historical distribution of these taxa in Nebraska, the reader is referred to Jones (1964), Jones and Choate (1980), and Jones *et al.* (1983).

Discussion

Prior to afforestation, native habitats on the Bessey Division of Nebraska National Forest consisted of grasslands and riparian communities. The grasslands may have contained a few scattered trees, but there were no forests in this region. The only wooded areas were narrow bands of bushes and trees along river banks. Today, a man-made, coniferous forest covers a large part of the original grassland habitat on the Bessey Division. Our study was conducted to determine how native mammals on this property responded to the presence of a forest in the Sandhill Region of Nebraska.

Below we evaluate each native species of mammal on the Bessey Division as to whether or not it has: 1) been inhibited in its local distribution or decreased in relative abundance because of the man-made forest, 2) expanded its range on the forest property or increased in numbers because of the plantations, or 3) showed little or no change in its distribution or numbers as a result of afforestation. We expected that some species living in the riparian communities (primarily deciduous vegetation) might expand their ranges to include the new coniferous forest, and that many species of the grassland might be excluded from the man-made forest.

There are 21 species of mammals on the Bessey Division that commonly live in grassland habitats of central Nebraska (Jones, 1964; Jones *et al.*, 1983; this study). Our findings indicate that seven of these species definitely are inhibited in their distribution in at least one of the man-made habitats on the Bessey Division. These species are *Cynomys ludovicianus, Geomys bursarius, Perognathus flavescens, Dipodomys ordii, Reithrodontomys megalotis, Microtus ochrogaster,* and *Antilocapra americana.* Although we have relatively little information on some of the other species, we suspect that the following 10 species also are inhibited in distribution or relative abundance: *Lepus californicus, L. townsendii, Spermophilus franklinii, S. spilosoma, S. tridecemlineatus, Perognathus flavus, Chaetodipus hispidus, Reithrodontomys montanus, Onychomys leucogaster,* and *Taxidea taxus.* These mammals of the Sandhills use grasses as a food source and for protection or, in the case of *Taxidea,* use the open grasslands to hunt their preferred prey. Trees on the Bessey Division displaced grasses and reduced optimum habitat; consequently, these mammals have been limited in distribution or density on the Bessey Division.

Odocoileus hemionus is common in the open grasslands of the Sandhills, but in most other parts of the country, it prefers wooded habitats, open areas with scattered trees, and forest edge situations. With the planting of coniferous trees, the preferred habitats have been increased. Because mule deer roamed the grasslands of the reserve before afforestation, they have not expanded their distribution on the Bessey Division, but may have increased in numbers because of man's activities.

Peromyscus maniculatus is primarily a grassland inhabitant of central Nebraska, but it also is known to live in wooded habitats throughout the Northern Great Plains, especially when the woods are not occupied by *P. leucopus* (Jones *et al.*, 1983). It is not surprising, therefore, that *P. maniculatus* is common in ponderosa pine plantations where its congener is rare (Table 1). In the riparian habitats where *P. leucopus* is most abundant, *P. maniculatus* is rare. Of interest perhaps is that both species coexist in fair numbers in cedar plantations of the Bessey Division. *Peromyscus maniculatus* is able to utilize all four types of plantations, and we consider this mouse unaffected by man's activity.

Canis latrans is a common grassland species of central Nebraska that also is known to live in wooded habitats on the Northern Great Plains (Jones *et al.*, 1983). This species is able to

use the man-planted forest of the Bessey Division and remains unaffected by man's activity.

The last of the mammalian species on the Bessey Division that commonly lives in grassland habitats of central Nebraska is *Cryptotis parva.* Although we have scanty data on the habitat distribution of this species on the property, there is a possibility that this insectivore also has been unaffected by the forest.

Seven other species of mammals found on the Bessey Division appear to be unaffected by existence of the forest. *Castor canadensis, Ondatra zibethicus,* and *Mustela vison* are semiaquatic and are normally restricted to waterways in Nebraska. The presence of the new forest has not increased or decreased their preferred habitat and their distributions on the forest property remain unaffected. Similarly, *Sorex cinereus, Blarina brevicauda, Microtus pennsylvanicus,* and *Zapus hudsonius* are ecologically tied to lush vegetation often associated with riparian communities. Because this type of mesic habitat has not been changed by planting of the forest, these mammals also remain unaffected by man's activities.

Based on our study, the following six species of mammals definitely have benefited from the presence of a forest on the Bessey Division: *Scalopus aquaticus, Sylvilagus floridanus, Sciurus niger, Peromyscus leucopus, Erethizon dorsatum,* and *Odocoileus virginianus.* These species are ecologically tied to woodlands or moist soils and have expanded into the new forest from the riparian communities. These species are utilizing trees, moist soils under trees, or the litter layers associated with plantations.

Based on the natural history of the following mammals in the Northern Great Plains (Jones *et al.*, 1983; this study), we suspect that *Didelphis virginiana, Vulpes vulpes, Procyon lotor, Mustela frenata, Spilogale putorius, Mephitis mephitis,* and *Felis rufus* also have benefited from the forest and occasionally take advantage of this new habitat. All four species of bats from this region are known to roost in trees. We opine that these species have benefited from planting of the forest, and the presence of *Lasiurus borealis, L. cinereus,* and *Lasionycteris noctivagans* in a ponderosa pine plantation supports our contention.

Comparison of Habitats

A summary of diversity and relative abundance of small-bodied, ground-foraging mammals for each of the habitats on the Bessey Division is presented in Table 2. Data in this table are derived

TABLE 2.—*Diversity and relative abundance of small, ground-foraging mammals on the Bessey Division of the Nebraska National Forest at Halsey. Data are derived only from our live-trap study except that diversity also includes animals collected by others. Relative abundance is given as the total number of individuals of all species captured per 100 trap nights. Diversity represents total number of species per habitat.*

Habitat (trap nights)	Diversity	Relative Abundance
Riparian habitats		
Subirrigated areas (275)	6	21.0
Well-drained areas (699)	8	17.6
Grasslands		
Grazed by cattle (545)	8*	5.3
Ungrazed by cattle (425)	7	11.9
Blowouts and catsteps (864)	5**	6.5
Plantations		
Eastern red cedar (450)	6	26.3
Ponderosa pine (300)	3	7.0
Jack pine (300)	3	4.3
Burned plantations (975)	8***	11.6

*includes *Perognathus flavus* and *Spermophilus tridecemlineatus* collected by others (see text).
**includes *Perognathus flavus* and *Spermophilus spilosoma* collected by others (see text).
***includes *Onychomys leucogaster* collected by others (see text).

only from our live-trap study except that diversity also includes those species mentioned in the text that were collected by others. We realize that diversity is influenced to a certain degree by trapping intensity (number of trap nights), and we have taken this into account in the following discussion.

In the riparian community, both habitats have similar diversity and composition of species except that the drier, well-drained areas also contain *Microtus ochrogaster* and *Peromyscus maniculatus*. Subirrigated areas, on the other hand, have slightly higher numbers of individuals (Table 2). In comparisons between the Middle Loup and Dismal rivers, both relative abundance and diversity of small mammals are higher along the Middle Loup. The Middle Loup exceeded the Dismal by 10 and 23 more individuals per 100 trap nights in well-drained and subirrigated areas, respectively. Higher numbers of individuals in the well-drained areas likely are related to denser stands of trees and more fallen debris in habitats along the Middle Loup. These areas provide more shelter, protection, and food—especially for *Peromyscus leucopus*, the most common resident of this habitat. The main reason for the higher number of individuals in subirrigated areas probably is because the Middle Loup River has more continuous and broader bands of this habitat. We captured

eight species along the Middle Loup, but only *Peromyscus leucopus, Zapus hudsonius,* and *Sorex cinereus* have been taken along the Dismal. Because most of our trapping in riparian communities was adjacent to the Middle Loup (90 percent of total trap nights in riparian communities), we suspect that the number of species associated with the Dismal will increase with additional trapping.

Grasslands on the Bessey Division today are grazed by cattle (*Bos taurus*). In the past, bison (*Bison bison*) grazed the area in a way that produced a mosaic of grazed and ungrazed grasses (Koford, 1958). When comparing the abundance of small mammals in the grasslands today, ungrazed areas have more than twice the number of individuals than do those that have been grazed (Table 2). Ungrazed areas have greater density because thicker vegetation provides more food and protective cover for small mammals. Both types of grassland have similar diversity and composition of species, except that *Microtus ochrogaster* was taken in ungrazed areas and *Perognathus flavus* and *Spermophilus tridecemlineatus* were captured in grazed areas. The sandiest areas on the Bessey Division (blowouts and catstepped slopes) have low diversity and are inhabited primarily by *Dipodomys ordii.*

Burned plantations, which resemble grasslands with scattered trees, have similar numbers of species and individuals as ungrazed grasslands (Table 2). The major difference is the presence of *Peromyscus leucopus,* a woodland species, in the burned plantations. Cedar plantations have the highest number of individuals compared to any other habitat on the Bessey Division (Table 2). Cedar plantations have similar diversity (although the composition of species differs) as native grasslands and have greater diversity than unburned pine plantations. Several factors may contribute to this situation: 1) cedar trees produce abundant amounts of small seeds and small fleshy cones that fall to the ground and are readily available as food for many species; 2) cedar stands are extremely thick, making it difficult for large predators to capture prey; 3) mammals living in cedar stands would experience less environmental (climatological) stress than mammals living in open grasslands. For example, Neiderhof and Stahelin (1942), studying a jack pine stand on the Bessey Division, showed that wind movement and evaporation is much lower in plantations than in grasslands, and that soil temperatures are significantly warmer in winter and cooler in spring,

summer, and autumn inside plantations than in grasslands. Precipitation reaching the ground is significantly less inside plantations than outside them. And finally, trapping success may be higher in plantations because it is darker under the thick canopy of branches, and some literature suggests more mammalian activity and, therefore, higher numbers of captures on dark nights.

Stands of ponderosa pine have slightly higher numbers of individuals than those of jack pine (Table 2). This may be due to the fact that: 1) in Thomas County, only ponderosa pine is growing in its historical range (Little, 1971) and probably produces more seeds per tree; 2) ponderosa pine normally produces larger seeds (six to seven millimeters) than jack pine (four to five millimeters); and 3) cones of ponderosa pine open on the trees and release their seeds, which then accumulate on the ground. In contrast, cones of jack pine often remain on the trees for several seasons and frequently fall intact. This makes them harder for small mammals to process. Both pine plantations have the same diversity, but the composition of species is different. Both *Peromyscus* were caught in each plantation, but only *Reithrodontomys megalotis* was taken in ponderosa pines and only *Perognathus flavescens* in jack pines.

Summary

1. A large coniferous forest was planted in the Sandhills of Nebraska in the early 1900s. This forest and its surrounding area of native grasslands and riparian communities are known as the Bessey Division of the Nebraska National Forest.

2. Our study was conducted to determine how the 45 native mammalian species on the Bessey Division responded to the presence of a forest in the Sandhills.

3. Thirty-eight percent of the native species of mammals on the Bessey Division are negatively influenced by the man-made forest. Although there are some notable exceptions, those species commonly found in grassland habitats of central Nebraska are species inhibited by the forest.

4. Forty percent of the species are positively influenced by the forest. These mammals are primarily woodland species of the riparian community.

5. Twenty-two percent of the species remain unaffected as a result of man's activity on the Bessey Division. These species

primarily include the semiaquatic mammals and those ecologically tied to lush vegetation along waterways.

6. Relative abundance of small, ground-foraging mammals was greatest in cedar plantations, even greater than in native habitats.

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Dedication

We dedicate this paper to J. Knox Jones, Jr., because of his pioneering work on Nebraskan mammals. His treatise, *Distribution and Taxonomy of Mammals of Nebraska*, stimulated us to work on mammals in this unique ecological region.

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